CHEMISTRY

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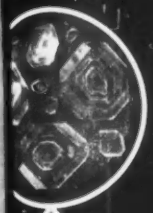

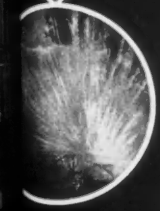

OVEMBER
1961

NEW WEAPON AGAINST INSECTS

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Editorial:
New Aids to Teaching Chemistry
Inside Front Cover

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A SCIENCE SERVICE PUBLICATION

New Aids to Teaching Chemistry

➤ THE MANY DEVELOPMENTS in the revision of chemistry courses for high schools and in various programs for assisting both the teachers and the students make this an exciting time for both student and teacher. The importance of chemistry to our society is receiving wide recognition.

This magazine has carried numerous reports of the activity of the Chemical Bond Approach Study and the Chemical Education Materials Study. Both of these groups are making valuable contributions to the teaching of chemistry in the secondary school. They have produced important additions to the literature for classroom use as well as for school laboratory use.

The Manufacturing Chemists' Association has conducted a program for assisting the teaching of chemistry for the last five years. Spurred on by the growing need for chemists in research and development, the chemical industry plans to continue this program at an increased tempo. One area of assistance by this group is directed at the junior high schools. A second area is directed towards college teaching. This consists in the selection of outstanding teachers for recognition. A third area is directed towards senior high schools and consists in the development of special experiments designed to create problem solving situations. The fourth area involves the production of teaching films. The fifth area is devoted to aid to elementary schools.

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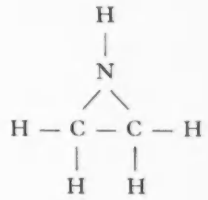
Chemosterilants

New Researches on Chemicals Promise Extraordinary Control Over Insects by Stopping Their Sexual Reproduction. Ethylenimine Family of Chemicals (Formula at Right) Gives Most Promising Derivatives.



▶ CHEMICALS are being used successfully to stop the reproduction and thus limit dangerous, destructive, disease-bearing insects, the U. S. Department of Agriculture has reported.

Derivatives of ethylenimine, a family of chemicals used in cancer-therapy research, have effectively sterilized insects, completely halting reproduction in test colonies of houseflies, mosquitoes, stable flies, screwworms, boll weevils and Mexican fruit flies.

The chemical causes sterility in houseflies, for instance, when they eat it or even when they walk over a treated surface. The flies live but their eggs do not hatch.

Chemosterilants for insect control have been under study for less than five years, but the sterility technique to get rid of such pests is not new. Insects have been sterilized in USDA experiments by exposure to radioactive cobalt-60 to control the screwworm in the Southwest. Because of the nature of the sterilant, the insects had to be treated in the laboratory and then released.

The radiation also affected sexual vigor. Studies show that male flies and mosquitoes sterilized with chemicals retain full sexual vigor and competitiveness.

A chemosterilant, nontoxic to warm-blooded animals, could be used in the field to sterilize native insect populations. It could be combined with an insecticide. The latter would reduce the population and the chemosterilant would destroy the reproductive ability of resistant survivors.

The effectiveness and promise of chemosterilants has been amply demonstrated. Now research will be aimed at finding how, when and where to apply chemosterilants to specific insects without creating hazards to humans, animals, crops or wildlife.

Finding the right compound can mean an annual saving of billions of dollars in the U. S. This is what the 93,000 different kinds of crawling or flying insect pests in the U. S. cause in agricultural losses.

Details of Chemosterilants

Agricultural Research (Nov.) issued by the U. S. Department of Agriculture, described the new research results as follows:

The possibility of using chemicals to sexually sterilize insects — as a means of control or eradication by preventing reproduction — is no longer just a scientific theory.

By treating laboratory-reared insects with minute quantities of sterilizing chemicals (chemosterilants) USDA scientists have completely halted reproduction in test colonies of several species — houseflies, mosquitoes, stable flies, screwworms, boll weevils, and Mexican fruit flies. Sterilized females laid no eggs, and the eggs laid by fertile females that mated with sterile males did not hatch. Sexual vigor and mating behavior were not affected.

In a preliminary field test, ARS entomologists of Orlando, Fla., almost eliminated a population of houseflies infesting a partially isolated refuse dump on a small uninhabited island. After 5 weekly applications of a bait containing a chemosterilant only a few flies could be found, and 99 percent of those captured were sterile.

As expected, the island was repopulated by houseflies from nearby islands and the mainland. Tests on a completely isolated island will be required to determine if eradication of houseflies can be achieved with chemosterilants.

The potential advantages of inducing sterility to control insects were first suggested by E. F. Knipling, head of USDA entomology research. This principle of insect self-annihilation is being intensively explored in ARS laboratories at Orlando; Kerrville, Tex.; Honolulu, Hawaii; and Mexico City, Mexico. Preliminary studies are also underway at other ARS laboratories. The scientists believe successful application of this principle could help us get rid of many destructive and dangerous insect pests.

The sterility technique was successfully used in 1958-59 to eradicate the screwworm from the Southeast. In that program, laboratory-reared screwworm flies were sexually sterilized by exposure to radioactive cobalt 60 and released weekly in sufficient numbers to reduce and finally wipe out the native screwworm population.

Advantages Offered By Chemicals

Chemosterilants have been studied for less than 5 years, but early results indicate they have advantages over the use of radiation:

Studies at Orlando show that male flies and mosquitoes sterilized by chemicals apparently retain full sexual vigor and competitiveness. In contrast, all species experimentally exposed to radiation have shown some degree of injury. Knipling estimates, for example, that sexual vigor of irradiated screwworm flies was reduced about 50 percent. This required doubling the number of sterile males released to provide the desired degree of competition with normal males in the native population. An effective chemosterilant that would not injure screwworm flies could have saved this extra cost and effort.

A safe chemosterilant could be used in the field to sterilize native insect populations. Sterile females would be incapable of producing progeny, and sterile males would compete with fertile males in mating with any females that escaped the sterilizing treatment. This double effect would result in rapid reduction of the insect population.

Using a chemosterilant against a *large* insect population in a natural environment would be cheaper and more practical than rearing, sterilizing, and releasing males. Also, any temporary hazard created by releasing additional insects would be avoided. If the infestation is *small,* however, the release of sterilized males would probably be more economical and practical. But even in laboratory sterilization, chemosterilants might be preferred to radiation not only because chemically sterilized males appear to be stronger and more competitive but also because, in some cases, costs might be lower.

Some 60 to 70 of the approximately 2,000 chemicals screened show some degree of sterilizing activity. Most promising are half a dozen derivatives of ethylenimine, a family of chemicals used in cancer-therapy research. These chemosterilants are considered toxic to warm-blooded animals and could only be used under carefully controlled conditions.

They could be used safely, for example, to sterilize artificially reared insects, as irradiation was used in the screwworm program.

They might be safely added to a powerful attractant, even though too hazardous for field use as conventional sprays or dusts. Attractants are now in use or being tested on the gypsy moth, tobacco hornworm, European chafer, and fruit flies. Intensified research is underway to find attractants for other insects.

Screening Is Expected to Increase

Screening of chemicals is expected to increase to several thousand a year, and evaluation techniques are being further refined. The scientists are optimistic, therefore, that the compounds they're working with are forerunners of chemosterilants that will be safe, even if applied as insecticides are now.

In fact, a combination insecticide-chemosterilant is visualized as one answer to the problem of insect resistance to insecticides. The insecticide would reduce the population, and the chemosterilant would destroy reproductive ability of survivors. Natural selection for resistance would automatically be halted.

Another joint use might be to apply an insecticide in areas where immediate control is essential, and then follow with a chemosterilant to prevent the surviving insects from rebuilding their population.

ARS entomologists and chemists emphasize that much more research must be done before chemosterilants can be used safely and effectively against native insect populations. The chemists must find the desired compounds, and the entomologists must learn how, when, and where to apply chemosterilants to specific insects without creating hazards to humans, animals, crops, or wildlife.

Nobel Prizes 1961

Chemistry

➤ UNRAVELING the secret of how the green leaf utilizes the energy of the sun is a scientific goal as important in its probable consequences as the discovery of atomic energy itself.

The researchers recognized by the award of the 1961 Nobel Prize in Chemistry to Dr. Melvin Calvin of the University of California, Berkeley, are among the few intensive efforts at the solution of this great chemical mystery. Compared with the rewards that would come from an artificial duplication of nature's photosynthesis, the amount of money and brains being directed toward this problem is considered to be very small indeed.

Dr. Calvin has approached this problem from two ends: determining how the biological process utilizes the light energy and how food and other substances are formed. In his laboratory at the University of California he is now working on filling in the knowledge between these two extremes in the photosynthetic process.

The citation for the Nobel award was for research on the carbon dioxide assimilation in plants. Dr. Calvin showed that photosynthesis is similar, in reverse, to the process of respiration in animals.

Dr. Calvin spent more than ten years on photosynthetic research using radioactive carbon, trying to resolve the basic steps in the process, which sustains all life on earth. He has been able to trace the intricate chemical mechanism by which plants convert water, carbon dioxide and sunlight into sugars, proteins, carbohydrates and other energy-bearing materials.

With co-workers at the University of California, Dr. Calvin developed the method of using radioactive carbon to follow the complex series of chemical changes carbon dioxide goes through in plants to build larger molecules that eventually become basic foods for man and animals. He also prepared radioactive sugar for use in this work.

Dr. Calvin began active investigations in the field of nuclear chemistry during World War II, when he served as an adviser on the atomic bomb project. In 1945 he established a research group at the University of California whose primary concern was to develop fields of study in which radioisotopes — radioactive forms of chemical elements such as carbon and hydrogen — could serve as tools for investigating fundamental problems in chemistry. Later Dr. Calvin worked out a method by which certain nonradioactive oxygen atoms could be traced through life processes by converting them to another substance which did show radioactivity. In this way, techniques used to detect radioisotopes of carbon and hydrogen could be extended to oxygen as well, a development which is extremely important in the study of life processes.

Dr. Calvin's studies of the origins of life developed out of his research in photosynthesis. Investigations of the storage and use of energy by

Photosynthesis Nobelist

Melvin Calvin

plants led Dr. Calvin to wonder how these living systems had developed in nature. In order to trace the development of life Dr. Calvin has attempted in the laboratory to duplicate conditions as they were on the primitive earth. In these experiments some of the molecules essential to life, such as

amino acids, were produced from substances believed to be present in the atmosphere billions of years ago.

Dr. Calvin has had plans and dreams of a really adequate research effort on photosynthesis which would involve a considerable number of millions of dollars of support, comparable to the money that was spent making the atomic bomb and is now being spent on the extensive inquiry on the nature and cure of cancer.

The award of the Nobel Prize for photosynthesis research may catalyze a large effort of this sort with adequate financing from foundations.

Dr. Calvin, a professor of chemistry, is director of the University's bio-organic chemistry group at the Radiation Laboratory.

Physics

➤ The two physicists who won this year's Nobel Prize in Physics each increased man's knowledge of the atomic nucleus, or core.

Dr. Robert Hofstadter, 46-year-old physics professor at Stanford University, Calif., was honored for his work using the Stanford linear accelerator to more clearly define the structure of the nucleus from the patterns produced when electrons are hurled at a hydrogen target.

Dr. Rudolf L. Mossbauer, now at California Institute of Technology, Pasadena, won the Nobel Prize for discovering in 1958 at the age of 30 that, under certain conditions, nuclei could emit or absorb gamma rays without any recoil, known as the "Mossbauer effect." Using this principle has already allowed scientists to confirm Einstein's principle of equivalence to determine the tiny magnetic field of the iron nucleus, and to provide the most accurate clock yet available.

Equally important is the promise of the Mossbauer effect in the field of solid-state physics, from which has come the transistor among other devices.

While at the Universities of Munich and Heidelberg, Dr. Mossbauer showed that some nuclear gamma rays of low energy could be emitted or absorbed without recoil if the atomic nuclei were tightly enough bound in solids and the temperature reduced. Gamma rays are identical to X-rays but are emitted from the nuclei of atoms rather than from the atoms' electron cloud.

Binding the emitting or absorbing nuclei in a solid also eliminates the broadening due to motion of the atoms caused by heat. In this way, radiation of phenomenally narrow frequency spread is provided, as well as an absorber perfectly matched in frequency.

The most recent result of the work of Dr. Hofstadter and his co-workers in probing the atomic nucleus is that two of the most fundamental building blocks of all matter appear to be virtually perfect mirror images of each other. They are the proton, which is a positively charged nuclear particle, and the neutron, a neutral one.

The proton is pictured as essentially a tight core of positive electric charge surrounded by two larger, somewhat

diffuse and interpenetrating clouds, also of positive charge. The clouds are made up of mesons, the nuclear particles believed to serve as the "glue" holding the nucleus together.

The neutron also has a hard core of positive charge surrounded by two diffuse and interpenetrating meson clouds. In this case, however, one cloud is negatively charged while the other is positive and extends somewhat farther out from the hard core.

These pictures were selected as the best fit for experimental information gathered by Dr. Hofstadter and his co-workers from the scattering of electrons accelerated and hurled at hydrogen targets in the Stanford machine. They were "drawn" in terms of the distribution of electric charges within the nucleus.

Medical

➤ This year's winner of the Nobel Prize in Medicine, Dr. Georg von Bekesy of Harvard University, is the world's leading authority on the functions of the ear.

The 62-year-old Hungarian-born scientist is senior research fellow in psycho-physics at Harvard and is not primarily a doctor of medicine although he holds an honorary M.D.

Dr. von Bekesy won the Nobel Prize for his work on the physical mechanism of stimulation within the cochlea, a cavity in the internal ear that resembles a snail shell. This cavity contains the important organs of hearing. These organs transform the vibrations received by way of the outer and middle ear into nervous impulses that are transmitted to the brain for translation into sound.

Hearing authorities say Dr. von Bekesy's outstanding contribution was in his development of the automatic audiometer in 1947, by which a person can trace his own minimal hearing level.

The von Bekesy type of audiometer is being used in hearing laboratories to develop tests for tumors of the auditory nerve. In this way a diagnosis of the cochlear and retrocochlear (behind the cochlea) functions can be made.

Dr. von Bekesy worked for many years in the research laboratories of the Hungarian Telephone System. He became interested, he once said, in the human ear when an economist asked him whether an improvement could be expected in the telephone system.

Another question of how much better is the ear than the telephone inspired him to glue tiny mirrors to the eardrum and record its response to sharp impulses. Then he pursued the problem into the inner ear itself, where he recorded and measured the traveling wave as it went along the ear membrane.

Among numerous awards Dr. von Bekesy has received was one of eight given in 100 years by the American Otological Society. The latest came coincidentally at the time the Nobel Prize of $48,300 was announced, when the Deafness Research Foundation in New York gave him its Merit Award Medal.

√ *Chemistry Quiz* √

Directions: Mark the answer you think *most nearly correct.*
Answers are on page 20.

A. The best evidence to date indicates that the space between the stars is sparsely filled primarily with
1. tritium
2. oxygen
3. helium
4. hydrogen

B. Which of the following materials is used for control rods in the atomic pile?
1. antimony
2. boron
3. carbon
4. titanium

C. Rare earths occur in all of the following except
1. cecite
2. cinnabar
3. gadolinite
4. monazite

D. For which of the following products is the bulk of the sulfur mined used?
1. sulfuric acid
2. sulfa drugs
3. rubber
4. superphosphates

E. Mercury is used as a solvent in refining
1. aluminum
2. calcium
3. potassium
4. silver

On the Back Cover

➤ SILICONE RUBBER AFTER 9000°F. — *General Electric showed samples of silicone rubber materials that had successfully withstood temperatures up to 9000°F produced in an electric arc supersonic wind tunnel at the Company's Missile and Space Vehicle Department in Philadelphia. The half-inch thick sample shown following tests is a material developed by G-E's Silicone Products Department, Waterford, N. Y. Following exposure of six minutes, a hard carbonaceous crust formed on the surface, leaving 70 per cent of the rubber intact. G-E said the results of the tests suggested that silicone rubber materials could be considered for use as thermal coatings in missiles and space vehicles where other protective coatings or sealants could not operate.*

Highlights from the September Meeting of the American Institute of Chemical Engineers in Lake Placid, N. Y.

Foams Are Big Business

Foam Market to Hit 800 Million Pounds

▶ THE NEXT FIVE years should be good ones for the foam industry. Both consumption and production will increase, and the industry will expand markets in the building, marine, insulation, electrical wiring, packaging, electrical household refrigerator, commercial refrigerator, textile and carpet cushioning fields.

This is indicated as the result of a survey made by John C. Tallman, Marketing Research Division, Development Department, E. I. du Pont de Nemours & Company, Wilmington, Del., and was the subject of a paper, The Foamed Organics Industry, delivered at the 45th National Meeting of the American Institute of Chemical Engineers.

The survey, which included studies of some 35 industries, was made at the request of four du Pont departments that manufacture ingredients used in the production of foams.

Mr. Tallman estimated that the demand for foams in 1966 will be approximately 800,000,000 pounds, and production will be some 740,000,000 pounds, compared with 248,000,000 this year.

He advised the producers of foams and their ingredients to "look beyond imitative uses (where foam merely replaces some other material in the construction of a product) to imaginative use (where foam is designed into a product to capitalize on its unique properties and to permit economies in production costs). The greatest value of the imaginative approach will lie in the extension of foam properties and technology to applications where foams have never before been used."

Severe competition among producers of foams "has been both beneficial and detrimental to the long-range future of the industry." Benefits include development of improved properties, economic incentives for use of foams instead of traditional materials, and new outlets for foams "developed through the sheer necessity of disposing of increasing inventories."

Detrimental effects of competition have been "erosion of the profits of most foam producers," in some cases leading to "quality reductions which might damage the reputation of foams

and restrict their future growth."

Here's the 1966 picture as Mr. Tallman sees it:

Upholstered furniture: 140,000,000 pounds, which includes 80 million pounds of urethane foams, 50 million pounds of latex foams, and 10 million pounds of vinyl foams — accounting for about one third of all cushioned furniture.

The bedding industry: 100 million pounds, including 60 million pounds of urethane and 40 million pounds of latex foams.

Seat cushions for automobiles and trucks: 50 million pounds.

Other automotive uses: 80 million pounds for padding instrument panels, sun visors, arm rests, upholstery for doors and side panels, carpet underlay, gaskets, seals and weather stripping, and possibility for thermal and acoustical insulation.

The textile industry: 20 million pounds, including 15 million pounds for thermally insulated outerwear and 5 million pounds for handbags and luggage.

The building industry: 85 million pounds, including 55 million pounds of polystyrene foam and 30 million pounds of rigid urethanes, which amounts "represent only a small fraction of the potential market; estimates indicate that the long range potential for foams in building insulation alone is over 1 billion pounds per year."

Mobile homes — house trailers: 20 million pounds. Insulation for low temperature warehouses, cold storage rooms, refrigerated railroad cars, refrigerated trucks and ships: 25 million pounds.

Electric household and commercial refrigerators: 50 million pounds.

Insulation for industrial piping and equipment: 25 million pounds.

Insulation for electric wiring: 30 million pounds.

Packaging industry: 30 million pounds.

Marine flotation products: 24 million pounds.

Fifteen other fields, including acoustical insulation, air filters, electric potting and encapsulating compounds, aircraft and missiles, railroad passenger cars, busses, shoes, floral and displays, houseware, industrial gaskets and seals, and military: 90 million pounds.

New Epoxy Foam as Insulation Material

➤ A SHELL Chemical Company research program has developed a new series of low density, rigid epoxy foams, whose features and competitive costs "suggest numerous applications within the appliance building, chemical, packaging and transportation industries, a Shell engineer reported to the 45th National Meeting of the American Institute of Chemical Engineers.

The foams "appear destined to become a major factor in the dynamic and rapidly growing foam field," R. P. Toohy, New York, said in a paper, Low Density Rigid Epoxy Foams.

"Although relatively new, compared with other types of low density foams, epoxy foams are finding increasing acceptance in all types of low temperature insulation. Epoxy foams are not only competitive in cost to other types of liquid foam systems, but are also considerably less toxic during the application phase."

Epoxy foams were first developed more than 10 years ago as light weight insulation material for electronic components. Since then continual progress has been made, with the foams being used in the aircraft and electrical industries, but their use has been somewhat limited by their handling characteristics and their relatively high density range, "which prevented them from competing effectively on an economic basis with both conventional insulation materials and with other types of foams."

The new epoxy foams, according to Mr. Toohy, have "a much broader range of potential application than heretofore possible." The new foams are "reaction products of bisphenol-A (a polyhydroxyl compound) and epichlorohydrin (a propylene derivative).

Both the resin and the curing agent components of these foam systems "have excellent storage stability." The components do not tend to settle out nor will continuous exposure to the atmosphere cause the resin components to polymerize.

The foams are classified as "one-shot" systems, in that no intermediate chemical manufacturing step is necessary between the raw material and the end user to control the heat of reaction, excess vapors or resultant foam properties. "This assures the end user of uniform product quality for the complete foam system."

Plastic Largely Air

▸ A PLASTIC, which was first introduced 14 years ago, but had a lagging market, today is one of the fastest growing in its family.

The plastic is polystyrene foam. Today "thanks to automatic molding machines, panel presses and extrusion systems, it is the fastest growing member of the styrene family of plastics," G. C. Kiessling, Koppers Company, Monaca, Pa., told the 45th National Meeting of the American Institute of Chemical Engineers.

Commercial production facilities are now turning out polystyrene insulation board and foam core panels for the building trade, all types of protective packaging, insulation components for the refrigeration field, light weight containers, complete small boats and for many other applications.

"Yet, even today there are new processing techniques and applications being developed which promise an even greater future success for polystyrene foam," he said.

Mr. Kiessling said that this organic cellular material "has demonstrated its unique versatility in an ever growing number of successful applications. Industry sources estimate that a potential usage of over 90 million

pounds will be attained by 1965. . . ."

When this plastic was first introduced, its "unique combination of properties were readily apparent," but lack of satisfactory equipment for economical processing held its development back, he said.

As a result of its cellular structure, polystyrene foam "has many interesting physical characteristics. This structure, which consists of many tiny closed cells containing air, has a high ratio of air space to polystyrene material. The small amount of material in the foam accounts for the extremely low density of polystyrene foam." It also has very low thermal conductivity, and offers very good resistance to the transmission of water vapor and absorption of moisture.

Urethane Foam Making 'Great Strides'

➤ A COMPARATIVE johnny-come-lately material is making rapid headway in the automobile world, J. R. Wall, of Inland Division, General Motors Corporation, reported.

Mr. Wall, in a paper, A Continuous Process for Urethane Foam Prepolymer, told the 45th National Meeting of the American Institute of Chemical Engineers that urethane foam was first used by the automobile industry approximately four years ago and since has made "great strides," particularly for use in automobile seats.

Use of this material grew from 10,300,000 pounds in 1959 to 16,000,000 pounds this year, a gain of 56 per cent. "Another advance to 19,500,000 pounds is forecast for 1963."

Urethane foam "began to make inroads into the automotive seating field as a substitute for foam rubber," Mr. Wall said, "because it was a less expensive material, since it could be produced at much lower densities, with comparable load-bearing properties."

Mr. Wall said that he looked "for this trend to continue, with urethane foam taking over more volume from cotton and curled hair, as well as foam rubber latex."

Urethane was first used in the automotive industry in a vinyl-covered instrument panel, but since has been used extensively in seat cushions and to a lesser degree in head liners and arm rests, he said.

New Frothing Process for Making Foam

➤ A NEW method of producing foam by frothing was described at the 45th National Meeting of the American Institute of Chemical Engineers. It was detailed by R. E. Knox, Elastomer Chemicals Department, E. I. du Pont de Nemours & Co., Wilmington, Del., in a paper, Frothing — A New Method for Producing Urethane Foam, presented at a symposium that surveyed the use and production of foams for automobile seats, insulation, boats, etc.

The foam frothing method "involves incorporating, at elevated pressures, volatile liquids, into a reactive polyurethane composition, which af-

ter mixing, is discharged to a lower pressure with subsequent partial expansion of the reacting materials."

The utilization of fluorocarbon 12 was "excellent" in obtaining resilient urethane foam frothing.

The new method produced a low density foam "comparable in quality" to conventionally produced foam. "Significantly process improvement ranging from lower moulding pressures, lower overall density to better foam stability, have been observed. The process and equipment have been laboratory tested with limited field confirmation. These results show that frothing has both processing and economic potential."

The process "expands the possibility of this interesting class of materials . . . " Frothing develops the characteristics of conventional polyurethane systems, self generating gas and cure characteristics which are "both unique and desirable." It "reduces or eliminates many of the restrictive problems inherent in conventional polyurethane foaming," and is adaptable to existing foaming equipment and procedures.

'Breathability' Makes Latex Foam Popular

➤ THE ATTRIBUTE of "breathability" is one of the important factors accounting for the popularity of latex foam rubber, a United States Rubber Company engineer said.

Latex foam's structure is characterized by interconnecting cells which permit passage of air upon flexing, Edward C. Svendsen, Mishawaka, Ind., observed in a paper, The Manufacture and Properties of Latex Foam. The paper was read during the 45th National Meeting of the American Institute of Chemical Engineers.

"This attribute, referred to as breathability, refutes the contention that rubber in contact with the body is hot," he said. "The ventilation feature yields a cooling efect, and is perhaps one of the outstanding reasons for the demand in many applications for latex foam."

The oroginal Dunlop process for making latex foam has satisfied the demands made on the major part of the latex industry, but "a more recent process has become an important alternate procedure adopted by several companies." It is known as the freeze gel or Talalay process.

Natural latex for many years was the only latex available, but of recent years a synthetic latex has been developed.

"In spite of significant developments with synthetic latex, the natural material still makes up more than one third of the total amount consumed."

The cost of natural rubber "has been the determining factor in its loss of market," Mr. Svendsen said.

In the last 15 years the price of natural rubber has varied from about 33 cents a pound to more than 70 cents a dry pound.

Latex foam is widely used as seats, cushions and pillows, among other things, and is "an important product of commerce that has 25 years of public acceptance and confidence," he said.

AICE Meeting

Close Liaison of Scientists and Engineers

➤ Close "design liaison" between research scientists and design engineers is "one of the most important considerations" in planning a research and development project, the American Institute of Chemical Engineers was informed.

Research and development projects differ from other projects in several ways, K. A. Clark, General Electric Company, Richland, Wash., pointed out in a paper, Project Engineering For Research and Development. Such projects should incorporate plans for expansion and versatility. "Programs are constantly changing and the same facility might be used for several purposes. The frontiers of science are constantly expanding so space must be provided for newer and different equipment which multiply the avenues of progress for any particular task . . . Another consideration . . . is the practicability of beneficial use and occupancy of part of the facility for a critical program while the remainder is being completed."

In liaison between research scientists and design engineers, "sometimes the best purposes are served when the scientist takes the time and effort to write equipment specifications and prepare work sheets for equipment design that is unique to his particular program. Close adherence to these criteria in detailed design can materially reduce design costs and expedite design completion."

When planning a new facility, a budget study "frequently brings to light deficiencies in prior planning."

There are certain advantages in the use of a cost-plus-fee contractor for expediting construction before the design package is complete, Mr. Clark said. On small jobs the work may be accomplished in much shorter time. Sometimes the fixed-fee payment is smaller than the cost of extras resulting from changes to a fixed-price contract. "Cost-plus contracts are especially useful in the installation of equipment where it is difficult to define exactly what will be required of the contractor before the work begins."

Mr. Clark warned that availability of equipment for a new purpose or process should be "thoroughly checked" before specifying in a contract or estimating for a proposal, as in some cases vendor catalogues and representatives "lead one to believe that advanced equipment or material is available that is only in the development stage or has been discontinued."

It also "is advisable to conduct a safety review of each segment" of a proposed new facility. "The safety engineer, customer, technical representative, and project engineer should make a critical inspection for hazards and make recommendations for their elimination or control. Project funds should be allotted to correct any such hazards deemed the responsibility of the project engineer."

Housewife Major Marketing Factor

▸ THE HOUSEWIFE is becoming a prime marketing factor in a "major revolution" taking place in the chemical industry.

This was emphasized at a marketing symposium during the 45th National Meeting of the American Institute of Chemical Engineers, by T. P. Forbath and N. B. Sommer of American Cyanamid Company, in a paper, The Changing Times in Commercial Chemical Development.

"We perceive a trend in which clear cut lines of demarcation between industries are disappearing — the chemical company no longer just makes chemicals — the steel industry no longer only steel, nor the oil industry only petroleum products. Our chemical business more and more has begun to fabricate its raw products and to market these end products to the retailers and consumer — necessitating whole new concepts of operation.

"Major emphasis is on marketing strategy with the elements of advertising and promotion looming large in the struggle to do the best job of courting our favorite consumer, the housewife."

The authors warned, however, that in this "major revolution," lie pitfalls in which the "proverbial green grass across the fence may be assuming its fall colors prematurely with the red ink of the accountant if sound judgement is not used along the way."

"In particular, the importance of learning properly to market to the consumer must be emphasized if we are to be successful in courting Mrs. Housewife. Selling to this unpredictable lady and to the buyer at Macy's is greatly different from calling on a purchasing agent in a chemical company. We must learn the effective use of advertising and promotion and we must be willing to appropriate the funds to enoble us to accomplish this. We must be marketers first and technical and production people second."

They stressed the importance of developing and producing good products, but this "may not be as important as an advance in packaging or a step forward in making the product more convenient to use."

Another "major pitfall" is the danger of developing and marketing a product which would be in direct competition with the company's other customers.

Small Company Has Best Chance

▸ THE SMALL chemical company has the best chance for success with new products in new markets, the American Institute of Chemical Engineers was told in a paper, How Market Development Looks to a Small Company.

The paper, describing Pygmakon, an imaginary small chemical company, was presented at a marketing symposium by James H. Boyd, a consulting chemical engineer and adjunct professor at Columbia University, New York. Pygmakon is a company

whose annual sales are about $2,000,000 compared with billion dollar sales of some of the giants in the industry.

"Only in the cases of a new market opening up for a new product can market developments have any chance for major rewards for Pygmakon," Mr. Boyd said.

"What should Pygmakon do?

"The answer is — get out and sell! Selling a new product exposes it to competition. This is the testing needed to determine its chance for survival. If it survives then it may have growth potential. Selling will determine this. If the new product sells and sales grow, it can become entrenched in use so that when competition is aroused and becomes active the competitive products are at a disadvantage to displace the established product. Pygmakon has obtained a time advantage which if exploited is difficult to overcome.

"This is most effective development of a market for a new product by a small company. It is active and direct market development in the market place with a minimum of risk . . . it is market development by selling."

He described Pygmakon as "a composite image of the critical stage a number of smaller growing chemical companies have passed through." Pygmakon "is truly a pigmy, albeit an agile, vigorous and intelligent, compared with the giants, with ability to grow," he said.

Compressors 'Heart of the Process'

➤ Compressors may form only a small part of the machinery in a chemical process plant but they frequently are "the heart of the process," and their "availability" may be the difference in profit or loss.

This was stressed at an economics of equipment selection symposium during the 45th National Meeting of the American Institute of Chemical Engineers.

"Availability" was defined as the on-stream factor, by D. J. Metroka and H. A. Weigand, of the Ingersoll-Rand Company, New York, in a paper, Selection of Reciprocating Compressors For Minimum Investment Consistant With Maximum Return.

"Many process concerns have emphasized a policy to reduce the capital outlay," they observed. "This, of course, is good business practice, but if it is consistent in maintaining a maximum return on the initial investment. The most expensive plant to own is not one which requires the greatest capital expenditure, but the one which which refuses to pay off."

After summarizing the cost of a compressor, "the purchaser should next check the return which can be expected from the machine. Many times this part of the economic comparison is glossed over or omitted. Actually, in a chemical process the addition of this evaluation may place initial capital cost differences in a startlingly different light.

"Although the compressor may be a small part of the total plant, in most cases the process ceases to produce if the gas stops flowing. Stoppage of the

machine may, therefore, idle a large investment. The actual function of the compressor is of tremendous importance.

"A primary measure of a compressor's ability to return its investment is its expected on-stream factor — or more specifically — its availability. In order to return the investment quickly, this should be extremely high, and it is suggested that both user and manufacturer should shoot for the impossible 100%. On-stream factor is ratio of logged operating hours compared to the total time interval under consideration. Compressor availability is the ratio of the time that the machine is in condition to return the investment, deducting any period for repair, inspection, or replacement of parts, compared to the total time period. The availability of all components within the process must approach 100% if the expected complete plant on-stream factor is to be high."

A one per cent difference in the expected availability "should make a substantial difference in the selection of equipment." They observed that in a refinery expansion of some $20,000,000, the reciprocating compressors will cost almost a million dollars and "are the heart of the process." Assuming a write-off of two years, this means $28,000 payout will be lost for each day the compressors fail to keep the process in operation. Over only two years a difference of 1% expected availability will amount to seven days additional on-stream time, or a gain of almost $2,000,000. This is equal to 20% of the price of the compressors."

CPPS Technique Used in Process Industries

➤ CPPS PLAYED a role in bringing the Polaris Missile to an operational basis well ahead of schedule. It also was utilized to develop on a crash basis the Minuteman Intercontinental Ballistic Missile (ICBM) and it has been used to help engineer and construct sky-scrapers, bridges, power plants, steel mills, chemical plants, etc., "in a more economic manner than heretofore."

CPPS, Critical Path Planning and Scheduling, was described "as a project management tool or technique that makes possible large economies in the engineering and construction of projects of all types. It was so described in a paper, The Application of Critical Path Planning and Scheduling to Engineering and Construction, prepared by L. B. Glaser and Relph M. Young, of the Lummus Co., New York, for delivery at the 45th National Meeting of the American Institute of Chemical Engineers. The method "is an application of the basic mathematics employed to solve network problems and enables a project manager to ascertain the precise status of his project at any given time."

The authors warned, however that "it is not a panacea for the project management function, but is an effective tool that, when properly used, enables the project manager to plan his project in much more detail than has been practical before, determine the most economic way to carry out

the project plan, and then effectively monitor the plan to achieve the goals set for cost and schedule."

They added that CPPS is not "a substitute for technical experience, qualified personnel, creative thinking, sound judgment, good labor relations, and the like. But when used in combination with these factors we have found it to be a valuable project management technique in the economic engineering and construction of process plants.

"As to the future, we see the CPPS technique being used more and more for cost and process reporting, for storing and retrieving vital project information, for conducting unit-cost analysis, and the like — all aimed at providing the means to enable us to render a more effective service to the process industries."

Radioactive Wastes Disposal Efficient

➤ IN THREE YEARS of operation the pressurized water reactor of the Duquesne Light Company at Shippingport, Pa., has discharged only 20 per cent of radioactive waste it was designed for, the 45th National Meeting of the American Institute of Chemical Engineers was told. In the three years there has been no incident when radioactivity was discharged into the Ohio River or the atmosphere in greater quantities than specified by the National Bureau of Standards, C. S. Abrams, W. J. Hahn and J. R. La Pointe, of the Westinghouse Electric Company, Pittsburgh, reported in a paper, Evaluation of the Performance of the Radioactive Waste Disposal System at the Shippingport Station.

This three-year period covers a complete cycle of operation for a pressurized water reactor plant from initial operation through a refueling operation and back to power operation," they said. "A basic principle of the waste disposal system at Shippingport is the segregation of wastes to take full advantage of the particular capabilities of several disposal processes." Basic waste disposal treatments include natural decay of radioactive materials, ion exchange, dilution in a turbine condenser effluent stream, separation of radioactive materials from waste by a standard evaporation process, retaining certain solid wastes at the plant site in underground storage tanks, incineration of certain wastes, and packaging of wastes for land burial.

Under an agreement with the Commonwealth of Pennsylvania, a maximum of 6,200 uc per day and yearly average of 1,590 uc per day of radioactive materials may be discharged into the Ohio River. The maximum microcuries discharged into the river was slightly over 10,000 in October, 1960.

"The operation of the Shippingport plant thus far has been characterized by coolant fission product activity levels considerably lower than the waste disposal system was designed to handle, they commented.

Nuclear Contaminants

▸ THE ELABORATE steps taken to prevent radionuclides from entering the environment, including the Columbia River, at the Plutonium Recycle Test Reactor at the Hanford Laboratories, Richland, Wash., were detailed at the 45th National Meeting of the American Institute of Chemical Engineers. The safety precautions were related by W. A. Haney, G. E. Backman and D. R. Koberg, of General Electric Company, in a paper, Liquid Waste Management Planning for the Plutonium Recycle Test Reactor.

The reactor is "inherently safe" and was designed "to contain radioactive materials released in a plausible nuclear incident," they said.

Waste disposal limits and monitoring facilities have been established "to prevent the chronic discharge of excessive amounts of radionuclides to the environment. "Waste streams leaving the site are monitored and discharged under controlled conditions and process solutions which might enter the waste through equipment failure "are monitored and treated to insure that a minimum potential exists for the contamination of waste streams."

"The basic criteria for the design and operation" of the reactor waste disposal facilities "were developed to assure that self-imposed limits — even more stringent than those promulgated by responsible authorities — will not be exceeded."

The control limit on the principal manhole was set at 5 millicuries per cubic centimeter, on the basis that, iodine 131 in the effluent with a total radionuclide of that concentration "would not result in a thyroid dose in excess of one rad to a child consuming river water downstream" of the reactor site.

Such an exposure, they said "is well within the recommendations of the International Commission on Radiological Protection for a year's dose to the thyroid of persons not occupationally exposed to radiation. Also assumptions relative to river flow, isotope ratios and water consumption used in arriving at the recommended limit were well on the conservative side." (A rad is one hundred ergs of absorbed energy per gram of absorbing material.)

The reactor is shut down for varying periods when the concentration of radioisotopes reaches MPC_w (maximum permissible concentration in water) for drinking water in the neighborhood of controlled areas.

Concentration limits are based on "conservative considerations between the waste monitoring station and the first downstream use of Columbia River water as a source of sanitary drinking water supply for Pasco, Wash.," a few miles downstream.

"The contributions of PRTR to the fraction of non-occupational MPC_w at Pasco during periods of normal reactor operation are estimated at less than 0.001 per cent. Any contaminat present under these conditions will be due to the presence of activation products in the shield coolant stream."

AICE Meeting

Gas to Ease Shortage of Water

➤ THE REFRIGERANTS used in your air conditioner and refrigerator may play an important role in easing the expected world-wide shortage of potable water, the American Institute of Chemical Engineers was informed during their 45th National Meeting.

Freon-31, Freon-21, methyl bromide, Freon-142B and Freon-12B1 "appear to be useful" in the hydrate process for desalting sea water, Allen J. Barduhn, Howard E. Towlson and Yee-Chien Hu, of the Department of Chemical Engineering and Metallurgy, Syracuse University, reported in a paper, The Properties of Some New Gas Hydrates and Their Use in Demineralizing Sea Water.

The paper was a report on an investigation that was inaugurated in July, 1959 "to determine the critical decomposition temperature and pressure of hydrates not previously reported, to determine more completely the thermodynamic relations for those hydrates that appear promising for use in desalting, and to determine other properties of the systems necessary for an economic evaluation of the process such as composition and rate of formation of the hydrate and solubility of the agent in water."

The paper described the hydrate process as a "comparatively new" one "in which pure water is separated from its solutions in a solid form by a reaction with certain agents to produce a gas hydrate." It was the subject of a recent article in Chemical Engineering Progress which told about the use of propane as a hydrate.

The hydrate process "is quite similar to the freezing process in which a direct contact refrigerant is used, in that heat is removed from salt water by evaporating a refrigerant intimately mixed with it to produce a solid form of water (ice or hydrate) free of salt, which is subsequently separated from adhering brine, and then melted by condensing the compressed refrigerant on it. The hydrate process thus accrues many of the advantages of the freezing process, such as absence of scale formation, very low temperature differences required for heat transfer, absence of membranes, etc. In addition, it has certain advantages over the freezing process mainly due to the fact that it operates at higher temperatures."

Messrs, Barduhn, Towlson and Hu discovered eight hydrates during their study.

√ Answers to CHEMISTRY QUIZ on page 8. A - 4; B - 2; C - 2; D - 1; E - 4. √

Radioecology

Highlights from the First Symposium of Radioecology at the Colorado State University in Fort Collins, Colorado

NEW RADIATION STUDY APPROACH

▸ A NEW approach to studying radiation effects on animals using the population, rather than the individual, has resulted in some significant findings for a Michigan scientist.

A study by Dr. j. S. Marshall, assistant research limnologist with the University of Michigan at Ann Arbor, has revealed that less than fatal doses of radiation have these effects on daphnia:

1. Although the death rate was not affected significantly, the birth rate was reduced significantly.

2. Increases in radiation intensity resulted in a decrease in the proportion of immature individuals, and an increase in the proportion of middle aged adults. The proportion of young adults was relatively unaffected.

3. Individual growth increased with increasing dose rate.

Dr. Marshall said his findings with daphnia — a minute water creature related to the shrimp — could not be projected to other species or humans. But the population approach would be valuable in studies of other species, he points out.

"Most previous studies have considered only the effect of radiation upon the individual or the average individual and not the population as a whole. This is the first study on the effects of radiation on such things as age distribution within the population," he explained.

The reason for the increased proportion of older individuals among the daphnia is that low doses of radiation — below the fatal level — first affected reproduction. This also accounted for the increased growth.

"In daphnia, the eggs are rather large in relation to the animal that produces them. Apparently the energy that goes into reproduction goes into growth when radiation halts the reproductive processes," Dr. Marshall said.

Scientists See No Radiation Hazards

▸ IF THE testing of nuclear weapons continues with no greater frequency and magnitude than in the past, fallout is not likely to present any hazard, two scientists attending a symposium on radioecology said.

Agreeing that past fallout and radiation studies have shown no measurable biological effects on man's environment were Dr. K. H. Larson, Environmental Radiation Division, Laboratory of Nuclear Medicine and

Radiation Biology, University of California, and Dr. John N. Wolfe, head of the Atomic Energy Commission's Environmental Science Branch.

In a morning press conference, Dr. Wolfe noted that in early tests all of the emphasis was on what effect the tests might have on man. He said that military necessity probably was the reason that little emphasis was placed on environmental studies prior to the early tests.

More recently — since 1947 — increased emphasis has been placed on the effort to find out what effect fallout has on man's environment, Dr. Larson said.

In this connection it was pointed out that recent Russian weapons testing will make it necessary to repeat certain phases of environmental studies being conducted in Alaska by the United States.

Radiation Has Beneficial Uses

➤ ALL radiation is not evil. Although the effects of radiation are generally thought as harmful, radiation has been used to produce improved varieties of flowers, a barley variety that grows and matures inside the Arctic Circle and an Hibiscus plant that will grow 1,000 miles farther north than the parent plant.

Dr. John D. Spikes, University of Utah biologist speaking at the Radioecology symposium cited these and other beneficial results of radiation as a scientific tool.

In the experimental stage, Dr. Spikes said, is the use of radiation to prevent sprouting of onions and potatoes in order to improve their keeping qualities.

Generally, high dosages of radiation are harmful to plants but different plants react differently. Coniferous evergreens are killed in a season or two when radiated with only five roentgens (a radiation measurement) each day. Gladioli can withstand 5,000 to 6,000 roentgens of radiation each day through the growing season, he said.

One of the advantages of radiation in plant breeding is the production of mutations, Dr. Spikes said. Mutations — hereditary changes — occur naturally in plants but not very often. Radiation of seeds, parts of plants and entire plants causes more frequent mutation than normal and gives plant breeders wider use of experimental plant material in a much shorter time than would occur naturally.

A rust resistant oat variety was developed from a mutation caused by radiation. It took three years for the scientists to develop the variety.

Under natural conditions it would have taken the scientists eight to ten years to develop the variety because of the slowness of plants to mutate naturally, he said.

In the field of plant biology, radiation offers scientists a tool to learn more of the intricate process of photosynthesis plant metabolism, uptake of nutrients, and the transmission of plant diseases.

Lethal Radiation Dose

▸ It is now possible to predict the amount of radiation living cells can withstand, a Brookhaven National Laboratory scientist said.

He is Dr. A. H. Sparrow who spoke at the first radioecology symposium on the Colorado State University Campus.

He said he predicted lethal dosage can be applied equally to cells of plants and animals but that it works only with cells in a single bit of tissue. It still doesn't tell how much radiation a human can take because the human body is made up of many different kinds of tissue containing cells that vary in the amount of radiation they can withstand.

Generally the amount of radiation a cell can withstand depends on the size of its nucleus, he said. He likened the nucleus to a target and the radiation source to a rifle. The larger the target, the more bullets that are likely to hit it, he said.

There are other things that determine the amount of radiation a cell can withstand. One is the time between cell divisions and another is the number and size of chromosomes within the cell.

Most of the cereal grains used for food in the United States can withstand large doses of radiation without being killed.

"They will survive in case of an atomic attack if there is anyone left to work the land," Dr. Sparrow said.

Some of the plants that can take the greatest amount of radiation without being killed are those of the cabbage family — the cauliflowers, turnips, rutabagas.

The greatset immediate value of the discovery of how to predict lethal dose rates for cells is in its use in the laboratory and in teaching, he said.

Answers on Radiation Tolerance Level Needed

▸ It is not known whether suggested tolerance levels to radiation are too conservative, too liberal — or even whether they may be beneficial to life — an Atomic Energy Commission biophysicist declared.

P. S. Henshaw of Washington, D.C., said tolerance levels have been set in the range of 10 to 100 times background radiation levels. Based on observations of animals' manifest vigor, it is believed that lasting injury is produced by daily exposures substantially more than a 1000 times background level.

There is the greatest need for criteria and methods to determine tolerance levels, he declared.

Henshaw addressed the opening session of the First Symposium on Radioecology.

Calling attention to the perils of reckless and inconsiderate use of atomic energy on the animal species, Henshaw quoted the late ecologist, Aldo Leopold.

Leopold said: "Land despoliation has evicted nations and can, on occasion do it again. A harmonious relation to land is more intricate and of more consequence to civilization than historians seem to realize."

Resources despoliation can result not only from wanton and greedy consumption, but also from contamination of the environment with destructive agents such as ionizing radiations, Henshaw added.

Radiation Has Minimal Effect

➤ DANGER from considerable doses of radiation is virtually non-consequential — provided you're a micro-organism.

In other words, those minute beings floating around in the water and buried in the soil are likely to survive exposure to radiation which could destroy the higher forms of life — including humans.

These findings reported by a pair of scientists — James B. Lackey of the University of Florida and Carrie F. Bennett of the University of California — at the first symposium on radioecology on the campus of Colorado State University.

Further, the scientists reported, "we have not seen one single instance of morphological change in any micro-organism in several years of experiments."

That is, micro-organisms such as tiny bacteria, are unconcerned — and to an extent unaffcted — by radiation.

The report was based on studies by the two in both the field and laboratory with a number of micro-organism species.

Strontium 90 Buildup in Bones of Deer

➤ TESTS conducted in California from 1952 to 1960 showed a definite increase in the amount of strontium 90 found in the jawbones of deer, it was reported at the First Symposium on Radioecology.

The findings were reported in a scientific paper prepared by V. Schultz of the U.S. Atomic Energy Commission and W. M. Longhurst of the University of California.

The tests were conducted with yearling Columbia black-tailed deer in Mendocino county, California, about 70 miles north of the San Francisco Bay area.

Although further sampling is needed, it appears that the peak of strontium 90 accumulation following cessation of nuclear testing has been reached, the scientists reported. Specimens taken in 1961 are now being analyzed and results should clarify this point, they added.

In earlier sessions of the symposium, it was pointed out that such accumulations of strontium 90 in the bones of animals are well known. Unknown, other scientists have indicated, is just what the accumulation may mean biologically. The answer to that question will take much more time and much more study, they said.

Fallout Shelters Defer Death

▸ UNDER conditions of nuclear war, fallout shelters might only defer death for populations whose environment has been made untenable by high radiation levels, an Atomic Energy Commission scientist said.

In the keynote address to scientists assembled at Colorado State University for the First Symposium on Radioecology, Dr. John N. Wolfe, head of AEC's Environmental Science Branch, pointed out that whenever man's environment has been made incompatible with his existence he has had to emigrate or perish. Thus, if man has "no place to go," fallout shelters might offer only temporary respite from death, Dr. Wolfe said.

At the same time, he emphasized that at the radiation levels thus far measured "we can find no biological effects" on man or the plant and animal life on which his existence depends. This does not mean, he said, that no such effects exist. It merely means that much more must be learned about atomic radiation before those effects can be measured with any degree of certainty.

A great deal of information on such things as the Strontium 90 levels in the bones of creatures has been gathered, but none on what it means. Later it may be possible to determine what the effects are, but it will take time. Currently, any lethal effects would not show up in natural populations because if mutants were found it would not be possible to determine whether they were due to radiation, Dr. Wolfe said.

Short of nuclear war, man's existence and the use of atomic energy are not incompatible, he concluded.

Study of Plutonium Effects

▸ Two California scientists urged additional research on plutonium and its effects upon animals and plants at the First Symposium on Radioecology.

Dr. H. K. Larson and Dr. J. H. Olafson of the University of California's Daboratory of Nuclear Medicine and Radiation Biology, Los Angeles, said that while on one should be alarmed about the concentrations of plutonium 239 in th environment of man, more answers about the effect of this extremely hazardous material are needed.

Pointing out that the plutonium 239 isotope is superior as a nuclear fuel, it is destined to play an increasingly important role. Research indicates plutonium 239 radiation shortens the life span and induces bone tumors.

Reviewing research on plutonium, the Californians said it has been a part of our environment throughout history in extremely minute amounts. Measurable amounts have been present in soils and biological materials only since the first man-made plutonium was released in 1945.

Inhalation is considered as the primary source of entry for plutonium into mammals, the doctors said. Eating plutonium contaminated foods is considered a minor source.

Plutonium in the body is absorbed slowly by the body. Once is enters the blood stream, however, it is rapidly deposited in various body tissues, particularly bones and the liver. Elimination of plutonium from the system is a slow process.

Only small amounts of plutonium are found in the air, the scientists said. It is believed that only in a very small area at the immediate site of a nuclear detonation would the air contain more plutonium than man's tolerance levels.

"Plutonium is a long lived isotope. It has a half life of 24,400 years. That is, it would take 24,400 years for one-half the isotopes to decay naturally so they are no longer radioactive," the pair explained. "The effective half time in man has been estimated to be about 200 years.

Because of this long life, it is possible that present concentrations are only the beginning of a continuously rising trend. While the situation is encouraging, based on present knowledge, a much greater understanding of environmental reactions is needed, they concluded.

Fallout Over Sea Heavier

➤ NUCLEAR fallout appears to be heavier over the sea than on land, two Massachusetts scientists told the First Symposium on Radioecology.

Coastal soils show higher fallout than do those sampled remote from the coast, according to findings of Dr. Vaughn T. Bowen of the Woods Hole Oceanographic Institution in Massachusetts and Dr. Thomas T. Sugihara of Clark University, Worcester.

"It becomes possible . . . that the high apparent fallout over the sea is not, as first suspected, simply a consequence of the sea surface being the ideal fallout collector," the scientists reported. "Two other possibilities are evident: either the mechanics of oceanic high pressure cells results in preferential return to the troposphere of stratospheric air over the oceans, or there is some basic difference in the process of fallout collection on precipitation over the ocean, resulting in higher efficiency."

The scientists speculated that strontium 90 must be involved in the full circulatory cycle of the oceans, that its penetration to depths, by whatever process, must finally and repeatedly be followed by return to the upper layers. It is our prejudice, they said, though the data are still scant, that this return has begun to be seen.

Over very wide areas of ocean, they pointed out, which had for two years absorbed high fallout without much, if any, rise in surface Strontium 90, in late 1959 and 1960 these values took a sharp and significant jump. Especially in view of the reduction in fallout rate due to test moratoriums, this was hard to explain, they contended.

Sea-Derived Food Less Radioactive

▸ If both land and sea areas are equally contaminated by radioactivity, food derived from the sea would be less likely to have adverse effects on man, according to marine biologists attending the first symposium on radioecology at Colorado State University.

Citing results of studies conducted several years ago in the Pacific nuclear weapons testing area, the scientists said that the ocean has a "diluting effect" on radioactive isotopes of strontium 90. Conversely, marine life shows a higher concentration of isotopes from other elements, but these elements are shorter lived than strontium and hence not as critical a factor.

Marine life also tends to "discriminate" against the uptake of strontium. In addition, in a reaction occurring when a nuclear test is made, strontium tends to be precipitated out with calcium hydroxide and much of it falls quickly to the bottom of the sea, the scientist added.

They emphasized that no genetic abnormalities had been noted in fish examined during the studies. They described silt made up of tons of particles falling back on the surface of the sea as probably the "greatest killing agent for marine life," due to the smothering action occurring as the silt moves back and forth with the ocean currents.

Discussing the studies were A. H. Seymour, Paul R. Olson, F. G. Lowman and R. F. Palumbo, all of whom were with the University of Washington, Seattle, at the time the tests were conducted. Palumbo has since taken a position in Puerto Rico.

Protecting Resources From Radiation

▸ Immediate steps must be taken to insure re-establishment of our natural environment — both plants and animals — following either a nuclear "accident" or an all-out atomic war, an Emory University scientist said.

Dr. Robert B. Platt of Emory University, Atlanta, Ga., said that provisions must be made — possibly in the form of a modern-day "Noah's Ark" — reconstituting all elements of our environment if we are to achieve satisfactory recovery from a thermonuclear disaster.

Speaking at the first Symposium on Radioecology at Colorado State University, Dr. Platt described as "fallacy" the notion that "if we can provide protection for the human . . . that all else will also be provided for."

He emphasized that now is the time to initiate studies that will lead to actual planning for the preservation of all phases of environment.

Dr. Platt recommended the possible use of "transient irradiators" — devices to irradiate varied areas of the environment — as valuable methods for compiling an inventory of plant and animal radiation sensitivity.

With this knowledge in hand, he said, plans could then be made for shielding the vital members of our "biological economy."

Dr. Platt also urged the creation of a "study group concerned with the reconstitution of our biological economy following thermonuclear war."

He said the traditional historical approach to recovery of life, which dictates that nature will repair its losses, is not practical in the face of thermonuclear war.

He called for the experimental approach — introduction of carefully controlled radiation into certain areas of the environment, observing the results, and then acting in accordance with gathered information.

Other scientists reported on research projects designed to measure the sensitivity of certain trees to radiation.

J. E. Giddens, also of Emory University, said that in a Georgia test area doses of mixed neutron-gamma radiation had "a pronounced effect" on the time at which hardwoods dropped their leaves. A summer dose of 15,000 "rads" caused leaves to turn brown and drop seven weeks ahead of the normal fall drop and almost completely inhibited leaf production the following year, he said. A lesser summer dose of 4,000 rads resulted in leaves falling only a week early — and those leaves showed the normal autumnal color change. In the latter case, however, total leaf production the following year was reduced by 39 percent.

The controlled radiation levels at which the tests were conducted, although described as "relatively low," were many times higher than normal background levels now generally existing, it was emphasized.

In similar controlled radiation tests on pine trees in Virginia, discoloration, death of terminal buds and inhibition of reproduction occurred after the trees were exposed to about 1,000 rads. Greater radiation dosages resulted in complete browning defoliation and death, according to R. A. Pedigo of the College of William and Mary.

Radioactivity Surveys on Air, Food

➤ The U. S. Public Health Service has intensified its work in a nationwide network of detection stations to spot potential health threats from radioactivity.

Dr. Francis J. Weber of Washington, D.C., chief of the services' radiological division, reported on some of these developments. Dr. Weber, a former Denverite, attended the First Symposium on Radioecology held on the Colorado State University campus.

In the last year, the number of milk sampling stations operated by the Public Health Service was increased from 10 to 60. The agency is cooperating with local and state health organizations in the operation of 45 air sampling stations throughout the nation, Dr. Weber said.

More than 100 stations are checking water for radioactivity through the National Water Quality Network. Both radio and chemical analyses are made on milk and water to determine

the amount of radioactivity and to identify the specific types of isotopes present.

"Particular emphasis is placed upon identifying strontium, cesium, and iodine isotopes, some of the longer lived types which are believed to be a threat to health," Dr. Weber explained.

While there has been no increase in the number of laboratories, the service is doing more sampling of food, he said. One of the current projects is to determine how much radioactive material is consumed in the average diet.

Dr. Weber said the amount of radioactivity found in food, water and the air, has been running well under the safe levels.

Dr. Weber says he personally feels that if there is continued weapons testing in the world for a period of time, these safe standards would be exceeded. And if these standards are exceeded for sometime, radioactivity could pose a threat even for the present generation.

"Fall out is a product of the size of explosion. From 1945 until 1958, all of the nuclear tests in the world totaled the equivalent of 178 megatons of TNT.

"We now read that Russia is considering testing 100 megaton weapons. Detonation of two of these would create more radioactive fallout than there has been in all previous tests," he concluded.

Nature Filters Isotopes

➤ WHILE some mountain snow banks are especially efficient in concentrating fallout isotopes, little radioactive material is found in the runoff water from these banks.

This was the conclusion of William S. Osburn, University of Colorado Scientist who has made a study of the situation on 11,400-foot Niwot Ridge in Boulder county. Osburn reported his findings at the First Symposium on Radioecology.

During the melting period, water percolates down into the snow and runs out at the base of the snow bank, Osburn explained. During this period, isotopes cling to dust, accumulated litter and small organisms in the snow bank and there is little radioactivity to the water.

After the meltwater leaves the snow field, it flows through a sedge mat, which also functions as a chemical-mechanical sieve to filter out litter and fallout isotopes. Nearly all of the fallout materials are trapped in the sedge mat, he said.

"The sedge mat which filters out the isotopes could do so indefinitely, even if the level of nuclear contamination were exceeded many fold," Osburn declared. "Often there is another sedge area at water reservoirs, so that water going into mountain storage lakes is particularly low in radioactive isotopes."

There are two threats to this natural filtration system, however, Osburn said. One is that if a cloudburst should occur immediately after the snowbank melts, much of the radiation-loaded litter that has not yet been incorporated into the soil would be washed out into lower areas.

Another problem is that the low amount of escaping radioactivity in water might emanate from one or two long-lived isotopes which are of great concern to man. If this isotope happened to be Strontium 90 or some other long-lived nuclide that might become concentrated in man's food chain, the low Beta activity of the water would not be a reliable indication of potential hazard.

Osburn suggests that the distribution of specific isotopes should be checked as thoroughly as gross Beta activity. He also called for studies of other mountain snow banks to obtain a total fallout concentration and release picture for high mountain areas.

Disposal of Peaceful Atomic Wastes

➤ Except in the case of a disaster such as an earthquake or sabotage, solid atomic wastes buried in the ground are not likely to affect man's environment outside the disposal area, two scientists told the First Symposium on Radioecology.

The paper was prepared by Dr. Donald W. Pritchard, director of the Chesapeake Bay Institute of the Johns Hopkins University and Arnold B. Joseph, sanitary engineer for the U.S. Atomic Energy Commission and delivered by Dr. Joseph.

Some radioactive waste is released to the atmosphere through peaceful uses of atomic energy, Joseph said, but concentrations from this source are relatively low.

The amount of atomic activity which could be potentially released to the sea or incorporated in marine plant and animal life from packaged wastes (again from peaceful uses) is small compared to the fallout from weapons testing, Joseph said.

"Only in the case of unconfined discharge of liquid wastes to the sea has there been any measurable concentration of radionuclides in the marine environment which could be attributed to waste disposal operations," Joseph said. "These activities have been shown not to exceed the safety norms for man established by competent national and international advisory councils and committees. No very evident impact on the marine environment itself has been observed for the cases where relatively large amounts of activity reach the sea. Detection of any subtle changes in the character of distribution of the marine plant and animal life must await the results of long-term studies."

Dr. Joseph defined three general sources of atomic wastes from peaceful uses of atomic energy: reactors, fuel processing plants and licensees. The wastes are liquid, solid and airborne. Some progress has been made, he said, in converting the wastes to use in Systems for Nuclear Auxiliary Power (SNAP), however these devices in time, become waste-producing mechanisms, requiring disposal.

As of last December, he said, the United States has $7 billion in nuclear plant facilities, 160 operating reactors all involving problems of waste disposal.

Science Talent Search
Project Report

Serum Amino Acids

Bernard S. Rappaport, 17, was a winner in the 20th Science Talent Search. In this report he tells of the use of chemical techniques he used in doing his project.

by BERNARD S. RAPPAPORT

New Dorp High School, Staten Island, New York

THE FREE amino acids in serum play a prominent role in the human homeostatic mechanism, and their quantitative levels may be altered in specific disease states. My many basic experiments with paper chromatography and related articles which I read in various medical journals made me aware of the increasing importance of paper chromatography in medical research. I therefore decided to devise a chromatographic technique for the quantitative analysis of human serum free amino acids, and to apply this technique to the possible diagnosis of diseases related to amino acid metabolism.

Technique Development

The technique consists primarily of excerpts from three published chemical procedures, to which I added several modifications based on my original theories.

A — *Chromatography*

A solution of several amino acids is placed on a rectangular piece of filter paper. The paper is suspended in a glass chamber and separation of the several amino acids is accomplished in two directions using phenol/distilled water and butanol/acetic acid/distilled water as the two solvents. The paper is sprayed with a ninhydrin solution which reveals the location of each individual amino acid as a purple spot.

B — *Quantitation:*

Each spot on the developed chromatogram is cut out, the purple color eluted from the spot with ethanol, and the optical density if this colored solution is determined in a Beckman spectrophotometer. The concentration of each amino acid on the paper is directly proportional to the optical density of the colored spot. (This was proved by comparing the optical density of several spots of the same amino acid, in varying concentrations.) I made graphs of each amino acid showing the linear correlation between concentration and optical density.

C — *Extraction:*

Having thus made *standard curves* of the standard laboratory amino acids, I was ready to quantitate free amino acids extracted from serum.

Ethanol is added to the serum sample to precipitate the protein. The mixture is centrifuged and the protein discarded; the supernatant fluid contains the *free* amino acids. This fluid is passed through an ion exchange column which retains only the serum free amino acids, eliminating unwant-

➤ Bernard S. Rappaport *shows his science display at an exhibition held in Washington as a feature of the twentieth annual Science Talent Institute. Bernard was one of the* 40 *winners who were chosen from over* 29,000 *high school seniors throughout the country.*

ed serum components. The amino acids are eluted from the column with ethanol and ammonium hydroxide. The eluate is evaporated to obtain the pure, dry, crystal, serum free amino acids.

This dried sample is reconstituted with isopropanol and chromatographed as previously described. Each amino acid spot is identified by comparison with a chromatogram of standard amino acids. The serum amino acids are then quantitated, as outlined, using the appropriate graph.

Modifications

The preliminary experimentation with the techniques was done in my home laboratory. It was therefore imperative that the technique, wherever possible, employ fairly inexpensive equipment.

— A — Conventional methods employ expensive chromatography cham-

bers to accommodate full length filter paper sheets. Having studied the theory of paper chromatography, I hypothesized that the position of the filter paper is not related to the effective separation of substances by chromatography; that the paper may be in any position which allows the solvent to ascend the paper and separate the amino acids. Experimenting with my hypothesis, I placed an amino acid mixture on one filter paper which I rolled into a cylinder. As a control, I placed an equal volume of the same solution on another paper which remained at full length. Both papers were placed in an expensive chromatography chamber which I borrowed. The papers were chromatographed. The cylindrical paper gave separations identical to those obtained on the full length paper. Continued trials of this controlled experiment confirmed my hypothesis. This enabled me to use cylindrical papers, placed in inexpensive gallon pickle jars to obtain accurate chromatographic separations.

Hair Dryer

— B — The literature suggests the use of vacuum desiccators (which are costly and time consuming) for the evaporation of the lute, described under *Extraction*. I hypothesized that since the sole purpose of evaporating the eluate is to obtain the amino acids in dry, crystal form, a vacuum is no more effective than a direct stream of air. Experimenting, I performed the entire technique on two separate aliquots of one serum sample. A home hair dryer was used to evaporate the eluate of one aliquot; a borrowed vacuum desiccator was used as a control to evaporate the eluate of the other. Identical quantitative results were obtained in the two cases; the hair dryer technique was sixty-eight hours shorter. Repeated identical experiments thus confirmed my hypothesis. This enabled me to reduce the cost and time required for this phase of the technique by using a commercial home hair dryer.

— C — In choosing the conditions for the chromatography phase of the technique, I tried some of the suggestions in the literature, including various temperatures, the use of ammonium hydroxide in the chamber to contract the amino acid spots, various solvent mixtures, and different filter papers. In my preliminary experiments, some of the papers were marked by a black discoloration. Using the notes I had made of the conditions under which each paper was chromatographed, I did a series of chromatograms — varying one condition on each paper (i.e. a change in temperature, ammonium hydroxide concentration, solvent mixture, or filter paper.) The paper which was chromatographed with a lower concentration of ammonium hydroxide exhibited less discoloration. On the next chromatogram I eliminated the use of ammonium hydroxide in the chamber and the discoloration disappeared. As the ammonium hydroxide was the variable altered on that paper, it was conclusively proven to be the cause of the discoloration.

For the subsequent chromatograms I eliminated the ammonium hydroxide and chose the combination of variables which provided the best results.

Applications

Having thus devised a method by which the free amino acids in human

serum may be quantitated, I sought opportunities to test the applicability of the technique to clinical research studies.

— A — Under the provisions of an Alfred P. Sloan Foundation grant, I became a member of a research team at the Division of Surgical Research at Harlem Hospital, N. Y., during the summer of 1960. This team had been formed to investigate the free amino acids in the problem of delirium tremens, which is a major, and often fatal, complication of many surgical patients.

Delirium Tremens

Most of the delirium tremens patients were chronic alcoholics and all had sustained a severe trauma of post-operative shock. The technique previously described, with the exception of the use of their chromatography chambers, was employed in the research. A survey was made of the quantitative free serum amino acid levels of the following patient classifications: chronic alcoholic, pre-surgical, post-surgical, and post-trauma patients. The technique demonstrated that delirium tremens patients had absolute deficiencies of many of the amino acids. Based on this finding, commercial preparations of amino acids and related compounds (e.g. L-monosodium glutamate, N-acetyl-d-glucosamine, and L-arginine) were administered intravenously by doctors. The curative results were encouraging.

The technique was also employed in testing the prophylactic applications of amino acid therapy. Patients whose amino acid levels were low, as demonstrated by the technique, were administered one of the commercial medications. Delirium tremens did not develop in most of the cases.

— B — I am presently continuing the study of the technique's applications — at the U.S. Public Health Service Hospital on Staten Island. I have applied the technique to the successful quantitation of the free amino acids in urine. I am therefore establishing a pilot project to determine the applicability of the technique to large scale clinical surveys of serum and urine free amino acids. If the technique continues to give reproductive, accurate quantitative results, I plan to expand the pilot project. The expanded research project would include a broad survey of the quantitative levels of the serum and urine free amino acids in apparently normal individuals and in patients with specific diseases. The literature indicates that diseases such as amino-acidurias, cystinosis, phenylketonuria, hepatic coma, and Fanconi's Syndrome would be fruitful areas for this investigation. All of these diseases are marked by an increase or decrease of the levels of specific free amino acids in the urine and/or serum of the patient. I am also continuing my efforts to decrease the money and time required by the technique with the hope of increasing its applicability, on a large scale, in the clinical diagnostic laboratory.

Summary

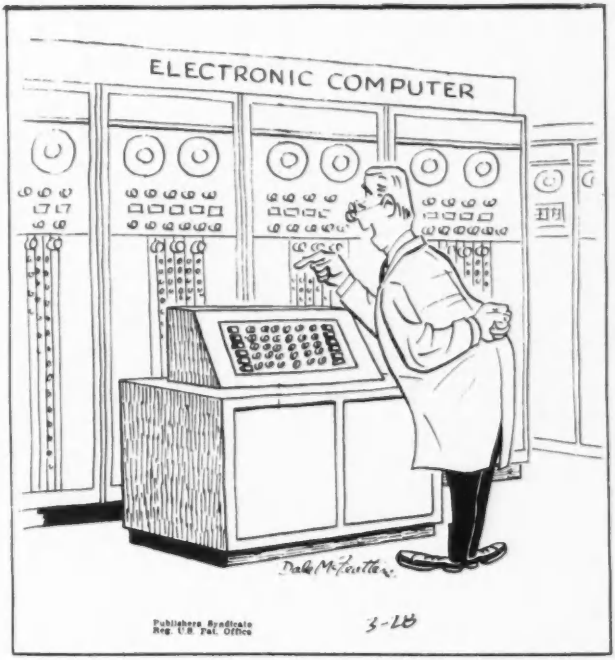
The technique, consisting of three chemical procedures and some original modifications, may be used for a quantitative study of free amino acids in human urine and serum. The technique is accurate to within a range of ± 5 per cent.

The technique has been successfully

applied to a research study of the cure and prevention of delirium tremens, using amino acid therapy.

The technique is presently being applied to a study of clinical syndromes marked by an alteration of the urine and serum amino acid levels.

The increasing importance of similar techniques in medical research indicates that this technique, if successful in my present research, may be applied on a large-scale basis as a quick, inexpensive, accurate diagnostic tool.



"Eenie, meenie, minie, mo — which button makes you go?"

Radiation Preserves Foods

➤ A NEW METHOD of preserving food which will make available fresh fish in areas far from the sea and fresh tropical fruit out of season is close to commercial testing.

Dr. Paul C. Aebersold, director of the office of isotopes development of the United States Atomic Energy Commission, Washington, told the Tenth Pacific Science Congress that mild doses of radiation can be used to reduce the growth of bacteria for weeks in perishable foods. This promises to compete with canning and frozen food in the near future.

The "low dosage" preservation of food, also known as radiation pasteurization, promises to be particularly important in the event of limited wars in which U.S. troops may be engaged in the future. Soldiers in the front line areas could be supplied with otherwise perishable foods without refrigeration.

An immediate commercial application is used on strawberries, which can be prevented from molding for weeks by low level radiation. The radiation is cheaply and simply available from some of the by-products of atomic reactors.

In India tests have shown that the ripening of mangoes can be delayed and this tropical fruit, usually not available to areas without refrigeration, can be made available widely in the future. Since for religious reasons, meat is not widely eaten in India and mangoes have excellent protein and nutrient qualities, this should be a major contribution to the Indian diet.

Another advantage to low dose preservation is that any larvae of dangerous insects would be killed by this method. For that reason fruits that otherwise could not be shipped into areas like the United States would be made safe for marketing.

For radiation pasteurization, a few thousand rads are necessary, which is only about one-tenth to a hundredth of the more massive radiation doses used in the food sterilization that the U.S. Army Quartermaster Corps is investigating. A rad is a unit measuring radiation somewhat similar to roentgens which are used to measure X-ray dosage. A rad produces 100 ergs of radiant energy per gram of the material being irradiated.

The apparatus for irradiating food probably in the future will be used in the food processing plants or even in the fields where the crops are being harvested.

The Atomic Energy Commission is undertaking a five-year study of this new food preservation method and experiments are underway at the Massachusetts Institute of Technology, Cambridge, Mass., at Seattle, and the University of California Agricultural Experiment Station at Davis.

The low-dosage irradiation supplements the work the U.S. Army Quartermaster Corps is doing at Natick, Mass., on high dosages of radiation capable of completely destroying bacteria, permitting food preservation without refrigeration for many months and years.

For the Home Lab

Algol Yellow R

by Burton L. Hawk

➤ Last month we discussed the preparation of anthraquinone from anthracene. If you have made this product, you may use it now for the preparation of Algol Yellow R, a typical vat dye of the anthraquinone group.

For best results, the crude anthraquinone should be purified by sublimation, as described in the previous article. The material should be in the form of light yellow, fluffy crystals. After you are finished you should have accumulated about ½ gram of product.

Dinitroanthraquinone

The first step involves the preparation of 1:5-dinitroanthraquinone. Dissolve the entire quantity of anthraquinone (about ½ gram) in 5 cc of concentrated sulfuric acid. Stir until the crystals are completely dissolved. Then slowly add ½ gram of powdered sodium nitrate. Add the compound in small quantities, stirring rapidly after each addition. It is now necessary that the mixture be kept at a temperature between 60 and 80° for a period of 12 hours. We suggest that you transfer the mixture to a small flask and immerse the flask in a larger container partially filled with water. Insert a thermometer in the water contained in the larger vessel. Place the whole apparatus over a very small flame or on a hot plate regulated so that the temperature will stay within the 60 to 80° range.

After the 12 hour period has elapsed, remove the flask from the heat and pour the contents in 50 cc of water in a beaker. Stir rapidly. A precipitate consisting of a mixture of 1:5-dinitroanthraquinone and 1:8-dinitroanthraquinone separates out of solution. The 1:5-dinitroanthraquinone is soluble in alcohol. Therefore, to separate the two compounds, add 70 cc of alcohol, stir thoroughly for a few minutes and then filter. Pour the filterate into an evaporating dish and set aside in a warm place to allow the liquid to evaporate.

Diamino-anthraquinone

The next step involves the preparation of diamino-anthraquinone. Place all of the 1:5-dinitroanthraquinone you have prepared (which won't be very much) in a beaker and carefully add a solution of 2½ grams sodium sulfide dissolved in 15 cc of water. Stir and apply heat. Gradually bring the mixture to boiling. The solution will turn dark bluish-violet in color and will thicken. This is due to the separation of diamino-anthraquinone and sulfur. Scrape the precipitate off the filter paper and dissolve in alcohol. It may be necessary to heat the alcohol to dissolve as much of the product as possible. Filter again. Since the diamino compound is insoluble in water, it may be precipitated by adding water to the alcoholic filtrate and separated by filtration. The filtrate is again allowed to evaporate, leaving behind the scarlet red diamino-anthraquinone.

Now, if we have not lost you somewhere along the way, we will proceed with the preparation of the dye. Add about ½ gram of benzoyl chloride (caution — handle carefully) and 2½ grams of dimethylaniline to the entire quantity of the diamino-anthraquinone which you have prepared (which won't be very much). Boil the entire mixture until the benzoyl derivative separates out as a yellow-brown powder. This should require about ½ hour. Finally, the product is filtered. Algol Yellow R is a yellowish powder technically known as 1:5-di(benzoylamino)anthraquinone.

As we stated previously Algol Yellow R is a typical example of a group of Algol dyes obtained from anthraquinone which are vat dyes. Vat dyes are insoluble in water, but on reduction they yield alkali compounds which are soluble. These compounds are readily taken up by fibers.

When the cloth is exposed to the air, the reduced compound is again converted to the dye which becomes very fast due to its insolubility in water.

Thus, in using a vat dye it is first reduced by an alkaline solution of sodium hyposulfite. The material to be dyed is immersed in this solution and then exposed to the air. Vat dyes are available in a variety of attractive shades.

Diabetics' Hearts Benefit

➤ ANTI-DIABETES drugs taken by mouth are under investigation for protecting diabetics against heart trouble, it was reported at the American Chemical Society meeting.

Oral anti-diabetes drugs decreased cholesterol synthesis in rat liver, Dr. Hugh J. McDonald of Loyola University, Chicago, said. High levels of cholesterol in the blood are believed by some to be responsible for the development of atherosclerosis, he explained.

It cannot be definitely established that the oral anti-diabetes drugs lower the levels of blood cholesterol in diabetics and protect them from atherosclerosis without extensive clinical studies, Dr. McDonald cautioned. The findings with the rat liver tissue are only preliminary, he said.

The anti-diabetes drugs cannot be used against atherosclerosis in non-diabetics, in spite of the extreme importance of this medical problem, because the drugs cause a drastic lowering of blood sugar levels. It is quite possible, however, he added, that the findings will point the way to the development of drugs that would be effective against atherosclerosis without affecting blood sugar levels. Such drugs might be used in non-diabetic patients.

The effects on cholesterol synthesis of oral agents now available to the public have not previously been reported. In fact it had even been suspected that the drugs might be helping the patient's diabetic condition, but at the same time exposing him to the bad effects of increased blood cholesterol levels, Dr. McDonald said.

Market names of the drugs being tested are orinase, debinase and DBI.

Apparatus Article

Two-Dial Torsion Balance

➤ THE SEARCH for new analgesics at Bristol-Myers research laboratory in Hillside, N. J. entails repeated weighings of synthetic organic compounds. Success depends on finding the medically active material from among an almost infinite number of such compounds. To save time and labor lab technicans now use a two-dial weight-loading torsion balance that yields significantly faster weighings with the required accuracy.

Thirty or more sample quantities of 5 to 50 grams are weighed per day at the Hillside lab on the compact and convenient two-dial balance. Weighing time is substantially less than with the beam-and-slide-weight balances previously used. Biggest time-savers are the dials developed by The Torsion Balance Company, Clifton, N. J. to load weights and make finer adjustments without arresting the balance. Conventional slide-weight bal-

ances must be arrested between each fine adjustment, adding two time-consuming hand motions to the operation.

For example, a typical weighing operation at the Bristol-Myers lab would involve the yield of an organic synthesis of roughly 47.7 grams. Flask and flask holder weigh, let us say, 100 grams. Placing a 100-gram weight in the right pan, the weight loading dial can be turned up in one motion immediately from 0 up to 50 grams without arresting and before the pointer swings over. This dial is returned to 40 grams by a simple twist and fine weighing is dialed in up to 7.7 grams, again continuously and without arresting the balance. Pointer swings are damped rapidly by a silicone fluid dash-pot for even faster readings. With a beam-and-slide weight balance at least three weights would have to be added to the right pan with arrests in between. The slide weight would then be moved up to 7.7 grams in at least six more motions, stopping each time to bring the balance to rest.

The 500-gram capacity torsion balance used in this lab is accurate to 50 mg — more than enough for most routine weighings in organic chemistry. By using dials for weight loading and fine weighing the Torsion DWL-5 balance minimizes the possibility of metric weights becoming inaccurate through excessive or rough handling.

In addition, the torsion mechanism which eliminates the wearing of knife edges, has retained its accuracy after more than one million weighings in laboratory tests. Other torsion balances have been used by the Bristol-Myers research laboratory in similar work for eight years and longer without requiring service or presenting any serious difficulty.

Process Removes Strontium-90 From Milk

➤ SHOULD the United States be hit by a nuclear attack, the milk supply, at least, could be made safe. The Agricultural Research Service, the Atomic Energy Commission and the U.S. Public Health Service have developed a process that removes 98% of the strontium-90 from milk.

The technique used in a complicated version of the water softening process: Citric acid is added to cold raw milk to ionize all the strontium. (Without the acid, only 60% of the strontium would be in ionized form.) The milk-acid mixture is then poured through tall columns containing an ion-exchange resin that essentially snatches the strontium ions out of the milk as it flows by.

The remaining steps are merely clean-up chemistry: The milk is treated with potassium hydroxide (an alkali) to neutralize the acid, then pasteurized and homogenized. Water added with the acid and alkali is removed by flash heating the milk in a vacuum chamber.

The process is now being tested on a pilot-plant basis at the U.S. Department of Agriculture's research center in Beltsville, Md., the developers reported in Agricultural Research.

New Chemical Patents

To obtain copies of these new patents, order them by number from the Commissioner of Patents, Washington 25, D. C. Enclose 25 cents in coin, money order or Patent Office Coupon (but not stamps) for each patent ordered.

Detonation Waves and Chemical Reactions

➤ IT HAS BEEN found that the unusual conditions of pressure and temperature existing in a detonation make this phenomenon ideal for the promotion of chemical reactions. The temperature, gas velocity, ignition characteristics and composition of the products of a detonation wave are determined primarily by the composition of the detonable material.

When an acetylene-oxygen mixture is used with an oxygen/carbon atomic ratio of one, the resulting atmosphere is slightly carburizing or reducing towards many substances. This ratio also produces the highest flame velocity and temperature. Ratios less than one produce more strongly carburizing or reducing atmospheres while ratios higher than one produce oxidizing atmospheres.

U.S. Patent No. 3,004,822 was issued to Richard M. Poorman and George P. Hawley of Speedway and to Herbert B. Sargent of Indianapolis, Ind., for their invention of a method for utilizing detonation waves to effect chemical reactions. They have assigned the patent to Union Carbide Corporation of New York.

They have utilized this method for the carburization of tungsten and molybdenum and for the reduction of iron oxide. In their invention they have improved the operating efficiency of the detonation gun by providing specially controlled combustion zones in the various areas of the gun.

Gas Centrifuge for Isotope Separation

➤ MECHANICAL gas centrifuges have been used for the separation of isotopes. In these centrifuges the rotation of a centrifugal drum provides a centrifugal force that acts upon the gas mass. This force causes a concentration of the heavier isotope towards the wall of the drum with a corresponding concentration of the lighter isotope towards the axis of the drum.

Karl Steimel of Konigstein, Germany has been awarded U.S. Patent No. 3,004,158 for a gas centrifuge which provides a centrifugal force due to the movement of a gas mass in a stationary drum due to the interaction of a magnetic field and a gas discharge current. He has assigned this patent to Licentia Patent-Verwal tungs-G.m.b.H. of Hamburg, Germany.

In this invention only a fraction of the gas molecules in the gas mass

need to be ionized due to the fact that the whole gas mass is made to move by the presence of a relatively small number of gaseous ions. This effects quite a savings in electrical energy over that required in the known electromagnet mass separators.

With this invention, circumferential velocities of the rotating gas mass greatly exceed those obtained in a gas centrifuge with a rotary drum. This increase in velocity permits a great increase in the separating effect of the centrifuge.

Cellulose Film By Cuprammonium

➤ THE USUAL process for manufacturing regenerated cellulose film by the cuprammonium process consists extruding the viscous cuprammonium cellulose spinning solution through a narrow slit into an alkaline aqueous coagulating bath. The extruded and coagulated film is then drawn through an acid "decoppering" bath to remove copper. The film is then washed and dried.

This process produces a film in which the cellulose molecules are oriented longitudinally in such a way due to the excessive stretching of the film as to give low transverse stability and a small degree of extensibility. The finished film also has an undesirable variation in properties from the middle to the edges.

A new process for the production of regenerated cellulose film that avoids these difficulties has been invented by Herbert Koren, Franz Hoelkeskamp and Paul Schubert of Wuppertal-Langerfeld and Rolf Linder of Wuppertal-Barmen, Germany. They were awarded U.S. Patent No. 2,962,765 for their invention. They assigned the patent to J. P. Bemberg Aktiengesellschaft of Wuppertal-Oberbarmen, Germany.

In the new process, the cuprammonium cellulose film is forced through an extrusion slot and conveyed on a roller at a speed about equal to the extrusion speed. The film is conducted through the alkaline bath and the acid bath at low speeds to avoid longitudinal stretching.

Two Infrared Detecting Systems

➤ DR. JOHN STRONG of Johns Hopkins University, Baltimore, won patent No. 3,005,913 for an infrared range finder. Rights were assigned to the U. S. Army. He found an improved method for detecting and locating distant objects that, although invisible, send out weak infrared radiation. Objects such as ships hidden by fog, haze, smoke screens or darkness could be detected by the range finder.

The instrument is like a conventional optical range finder except that it works for infrared radiation, using bolometers as detectors and electronic circuits for translating the detected radiations into indications of the angle.

William Feldman and Harry Frank Hicks, Jr., Rochester, N. Y., were awarded patent No. 3,005,914 for a new method of detecting the infrared radiation focused on a bolometer by means of a fixed optical system. They assigned patent rights to the U. S. Navy.

Origin of Volcanoes

The modern concepts of how the different shapes and structures of volcanoes originate are different from the ideas that have been given in the older geology and chemical books.

➤ THE MODERN concepts as to how the magma or rock melt is generated within the earth, how it changes its composition during its ascent to the surface to extrude as lava, and how the different shapes and structures of volcanoes originate were told by Dr. Hisashi Kuno, of the University of Tokyo's Geological Institute at the Tenth Pacific Science Congress at Honolulu.

The Hawaiian volcanoes are largely built up by repeated outpouring of fluid lava without being accompanied with violent explosions. As a consequence gentle-sloped flat mountains are formed.

Most Japanese and other volcanoes around the Pacific are built up by alternate outpouring of lava and explosive eruptions of fragmental materials such as ash and pumice from the central crater. Thus the steep-sloped cones such as Fuji-san, Japan, are produced. Powerful explosions caused by high concentration of gas in viscous magma is a common feature of activity in these cones, which often result in loss of human lives such as in the case of 1952 explosion of a submarine volcano Myozin-syo, south of Tokyo, and also devastate arable lands. Where magma is extremely viscous, it protrudes to the surface as a nearly solidified column of lava as was witnessed in the birth of Syowa-sin-zan in Hokkaido, Japan, in 1945. As a result of combination of these different types of eruptions, many circum-Pacific volcanoes have rather complicated structures and irregular topography.

Hawaiian lavas are mostly black basalt. Chemical analyses show that they contain about 50% SiO_2 The circum-Pacific volcanoes are made up of various types of rocks: black basalt, grey andesite with about 60% SiO_2, light-grey dacite and rhyolite with about 70% SiO_2.

It has been observed that more SiO_2-rich magmas tend to be lower in temperature and more viscous, and to contain more dissolved gas, mainly H_2O. These differences of physical and chemical properties of magmas cause difference of type of volcanic eruptions.

How are these different magmas generated is the fundamental problem in volcanology.

Seismologists believe that no permanent layer of magma exists with the earth down to the depth of 2900 kilo-

meters from the surface. Most probably, therefore, the magma is generated locally and temporarily by melting of solid rocks. The depth of generation of the magma appears to lie between several tens of kilometers and several hundred kilometers from the surface. This magma is of basaltic composition like the lavas of Kilauea and Mauna Loa, Hawaii. The heat energy necessary for melting the solid rocks is supplied by a slow convection current which is supposed to occur within the mantle of the earth.

The basalt magma thus generated rises to shallower depths, perhaps several kilometers from the surface, and forms a reservoir from which the materials to be erupted to the surface to form the volcanoes are directly supplied.

The magma within the reservoir then undergoes cooling, and crystallization of various minerals begins. Because these minerals are heavier than the magma from which they crystallize, they gradually sink toward the bottom of the reservoir. As this process goes on, the magma in the upper part of the reservoir becomes more and more enriched in those components which the minerals do not contain or contain in smaller proportions. The minerals contain as a whole more MgO and CaO than in the magma, and therefore SiO_2, alkalies (Na_2O and K_2O), and volatile substances, chiefly H_2O, are successively concentrated in the residual magma. This explains why the SiO_2-rich magmas (dacitic and rhyolitic) are lower in temperature than the SiO_2-poor basaltic magmas.

If the proportion of SiO_2 (and Al_2O_3) is high relative to MgO, FeO, and Ca), the atomic ratio Si + Al : O in the magma is close to 1:2, whereas if the proportion is low, the ratio is close to 1:3. If the ratio is close to 1:2, more O ions would be shared by Si and Al ions, resulting in higher degree of polymerization of the linked Si, Al — O groups which form the framework of the silicate structure. The higher degree of polymerization combined with the lower temperature of the SiO_2-rich magmas results in the higher viscosity. If the content of dissolved gas increases in such viscous magmas, powerful explosion may happen.

Canned Beef Tastes Fresh

➤ CANNED BEEF that looks and tastes fresh has been produced through the use of sulfur dioxide, the American Chemical Society at Chicago was told.

The new technique, which is inexpensive, permits the preparation of beef for canning by fast cooking at low temperature, which does not tend to cause toughness or stringiness, according to a report by Professor S. S. Block of the University of Florida department of chemical engineering. Although five per cent sulfur dioxide was used in most of the experimental

work, samples retained their natural flavor and texture after nine months when only .3 per cent was used, he said. Spoilage and bacterial growth were prevented.

During canning, meat ordinarily is boiled for 3 hours and then cooked for another hour under pressure to kill bacteria. Such vigorous treatment can toughen muscle fibers, dissolve the connective tissue between the fibers, and leave the meat stringy or watery, Professor Block told the ACS Division of Agricultural and Food Chemistry.

"The work does not attempt to provide a practical working formula for commercial meat preservation with sulfur dioxide, but merely demonstrates the preservative value of sulfur dioxide in meat and calls attention to the possibility of a simple, inexpensive, and effective method for preservation of meat in cans while retaining the taste properties of freshly cooked meat, Dr. Block said.

Sulfur dioxide is widely used to preserve acid fruits, but its value in preserving meat has not previously been investigated, it was explained. When acetic acid was added, the effectiveness of sulfur dioxide was prolonged, the chemical engineer said, adding:

"One-inch cubes of beef were cooked at 175-200 degrees Fahrenheit for 20 minutes in 8-ounce Mason jars, capped and incubated at 98 and 115 degrees Fahrenheit. Without preservative, the meat was invariably spoiled in 3 days.

"With .05 per cent SO_2 spoilage was delayed up to 6 months, and with .1 per cent some samples were unspoiled and without change in taste at 9 months. Samples with .3 per cent were all preserved at 9 months. Spores of *Clostridium orogenes* bacteria added to or injected into the beef were not killed by the preservative, but the bacteria did not proliferate when the jars were incubated.

"To increase the efficiency of preservation with sulfur dioxide, acetic acid could be added to lower the pH (alkalinity) of the beef after cooking without an acid taste being detected."

Since 5 per cent sulfur dioxide seemed to be the most satisfactory amount, this percentage was used as a criterion in studying other influential factors. At that concentration 710 parts per million of sulfur dioxide was detected in juice and 86 parts per million in drained cooked meat.

"Since volume of meat and juice is roughly equal after cooking, the average quantity of sulfur dioxide for the whole sample was about 400 parts per million.

"Consumption of one-half pound of meat per day preserved with 1,000 parts per million of sulfur dioxide would lead to ingestion of 0.227 grams. Health authorities would have to ascertain whether this quantity would be harmful if taken for long periods.

"Preservation with sulfur dioxide permits meat to be canned under time and temperature schedules that do not overcook the meat and which produce a quality cooked meat product."

A. L. Martinez, and Jean Bevis, also of the University of Florida were co-authors of the paper.

Proudly Presented

Announcing new developments in the chemical industry and newly available chemical literature.

High Vacuum Pumps Components Brochure

➤ HIGH vacuum pumps and components are the subjects of a new six-page, illustrated brochure recently published by Central Scientific Company, a division of Cenco Instruments Corp.

Described in detail is the Cenco series of two-stage Hyvac Vacuum Pumps ranging from 21 to 140 liters per minute. The pumps in this series work on a concentric rotor-rotating vane principle which significantly reduces noise and vibration.

Hyvac Pumps have a vacuum guarantee to better than 0.0001 mm. of mercury. The pump can be disassembled on location by inexperienced personnel without special tools in case small foreign objects are accidentally ingested or the interior of the pump is chemically contaminated.

Also detailed in the brochure are several Cenco high vacuum system components: the light weight, shatterproof Aluminum Safety Bell Jar; the Magnetic Stirrer for the stirring of liquids under vacuum conditions; and the Electronic Discharge Vacuum Gage.

Copies of the high vacuum pumps brochure are available by writing for "New Ideas from Cenco," Booklet #2, Central Scientific Company, a division of Cenco Instruments Corporation, 1700 West Irving Park Road, Chicago 13, Illinois, U.S.A.

Urethane Coatings Provide Superior Leather Products

➤ SHOES, luggage, and other leather goods with greatly superior scuff resistance, flexibility, and gloss retention are now being produced from side leather and patent leather coated with urethane finishes.

Harsh flexing tests show that patent and side leather treated with urethane coatings resist cracking 10 to 20 times longer than leather coated with conventional leather finishes, says Paul Maloney, Manager of Urethane Development for Trancoa Chemical Corporation, Reading, Mass. Trancoa specializes in urethane resins for coatings and adhesives and will tailor urethane resins to fit customer requirements.

Mr. Maloney points out that scuff-resistant urethane-coated leather retains glossy appearance two to three times longer than leather protected by regular finishes. Urethane leather coatings are not softened, dulled, or otherwise affected by wet or winter weather, he adds.

Leather finishers apply urethane coatings by a spray or by a "flow-coat" method which involves running leather sides under a V-shaped trough through which the coating flows. One or two coats are usually applied to patent leather. Each coat is dried by a baking for two or three hours at about 150° F. Patent leather for women's and children's shoes is presently the

biggest application of urethane leather finishes.

Side leather normally receives one urethane coat to upgrade the leather quality. If a relatively rigid coating is desired, the finish is force-dried in a few minutes. For a flexible finish, the urethane film is force-dried for a few hours.

Total thickness of urethane coatings on patent leather averages 1 to 4 mils. Urethane film thickness on side leather normally is less than 1 mil.

For more information on urethane leather coatings, write Department P. R. 2, Allied Chemical Corporation, 40 Rector Street, New York 6, N. Y.

Properties of Infrared Transmitting Materials

➤ INFORMATIVE 4-page folder on the properties of infrared transmitting materials is offered by Servo Corporation of America.

The folder reviews 15 materials, providing transmission curves and detailed properties on each. Among the properties covered are long wavelength transmission limit in microns; index of refraction; cold water solubility; soluble solutions; maximum size; and relative cost.

Copies may be obtained by writing Serve Corporation of America, 111 New South Road, Hicksville, L. I., N. Y.

Micro-Carbon Dioxide Determination Procedure

➤ NEW 8-PAGE methodology report available from Technicon Instruments Corporation describes procedure for automatic, continuous determination of carbon dioxide in biological fluids on as little as 0.05 ml. of specimen.

The micro-CO_2 procedure can be run at the rate of 40 determinations per hour and applies to both serum and plasma.

A complete rundown is provided on sample preparation and color reagents. A detailed flow diagram is included.

Copies can be obtained by writing Technicon Instruments Corporation, Chauncey, N. Y.

Ethane Useful in Tritium Measurements

➤ A NEW method of measuring the radioactivity of tritium, a hydrogen isotope, with ethane, a gaseous hydrocarbon, is being used at the University of California's tritium laboratory at La Jolla.

Three researchers in the University's chemistry department pointed out that much larger amounts of hydrogen, the only gas used to date for counting gas-phase tritium, can be put into a counter when the hydrogen is first converted to a hydrocarbon. The need for enrichment with tritium is lessened and the resulting measurements are more accurate, they said.

Drs. A. E. Bainbridge, Paula Sandoval and H. E. Suess report in Science that ethane, synthesized by mixing hydrogen with acetylene over a colloidal palladium catalyst, has "ideal" counting characteristics for low-level tritium activity.

The amount of radioactive tritium is used to date the age of recent air and water samples.

Book Condensations

ELECTRONIC PACKAGING WITH RESINS: A Practical Guide for Materials and Manufacturing Techniques — Charles A. Harper — *McGraw*, 339 p., illus., $11. Introduction to the developments in materials, methods and techniques employed in packaging electronic components.

ADVANCES IN PROTEIN CHEMISTRY, Vol. 15 — C. B. Anfinsen, Jr. and others, Eds.—*Academic*, 447 p., illus., $13. Reports on protamines, osmotic pressure, protein malnutrition in man and other research.

ASPHALT: Its Composition, Properties and Uses — Ralph N. Traxler — *Reinhold*, 294 p., illus., $10. Presents the chemical, physical, colloidal, rheological and durability properties of asphalt, its manufacturing and uses.

INTRODUCTION TO CHEMICAL ENGINEERING — L. Bryce Anderson and Leonard A. Wenzel — *McGraw*, 364 p., illus., $9.50. Surveys the professors of chemical engineering and the processes of the chemical industry.

ISOPROPYL ALCOHOL — Lewis F. Hatch — *McGraw*, 184 p., illus., $7. Comprehensive treatment of properties and applications of isopropyl alcohol.

ABSORPTION SPECTRA IN ULTRAVIOLET AND VISIBLE REGION (A Theoretical Introduction) — L. Lang, Ed. — *Academic Press*, 494 p., illus., ring-binding, $18. Results and data of recent experimental research work done at chemical and physical research institutes in Hungary.

THE CHEMICAL AND BIOLOGICAL ACTION OF RADIATIONS, Vol. V — M. Haissinsky, Ed. — *Academic Press*, 278 p., graphs, $8. On mechanism of the radiolysis of water by gamma rays, action of alpha rays, diffusion kinetics in radiation chemistry and mass spectrometry.

AMERICA'S FIRST WOMAN CHEMIST: Ellen Richards — Esther M. Douty — *Messner*, 191 p., $2.95. Juvenile biography about the first woman to study at MIT, fellow of the AAAS and first president of the American Home Economics Association.

CHEMISTRY AND TEXTILES FOR THE LAUNDRY INDUSTRY — Harry Cohen and George E. Linton — *Textile Bk. (Interscience)*, 429 p., illus., $15. Fundamental facts and technical data, a textbook and reference work.

PHOTOCHEMISTRY OF AIR POLLUTION — Philip A. Leighton — *Academic Press*, 300 p., $11. Formulates background for the study of photochemical processes which may convert relatively innocuous pollutants into substances which are nuisances and hazards.

DYEING OF CELLULOSIC FIBRES AND RELATED PROCESSES — S. R. Cockett and K. A. Hilton — *Academic Press*, 417 p., illus., $12. Discusses preparation of fibres, colorants, preparation and application of colorants, dyeing machines and finishing processes.

INVITATION TO CHEMICAL RESEARCH — E. Emmet Reid — *Franklin Pub. Co.*, 366 p., $10.60. Research chemist's reminiscenses and professional know-how for chemistry students.

Chemistry Comments

Interesting facts in the chemical world.

➤ Cesium-137, a beta and gamma ray emitter, has possible application in the preservation of food and sterilization of medical supplies.

➤ The spray 2,4-D injures the cabbage root causing slow growth or death to the plant.

➤ Ice cream smoothness is controlled to a large extent by ice crystal size.

➤ Nuclear batteries, radioisotope power sources, may soon be used as a substitute or recharger for ordinary storage batteries in remote locations.

➤ It has been reported that large doses of steroids have successfully checked the deadly kidney damage caused by systemic lupus erythematosus, one of the most serious rheumatic diseases.

➤ Radiocontaminants reach food in two principal ways, adsorption from air onto surfaces of plant materials and entry into soil and uptake through the roots of plants.

➤ Pyroceram, a material originally devised for nose cones, is now used for pots and pans which can be taken out of a freezer and immediately put in the hottest flame without damage.

➤ Strontium-90, cesium-137 and iodine-131 cause the greatest radioactive contamination of food as a result of nuclear tests.

➤ Chronic bleeding from the stomach and intestines may be corrected in some cases by treatment with iron, eliminating the necessity of surgery.

➤ According to tracer studies, at least some of the fats in atherosclerotic plaques are apparently made by the artery wall at the site where they appear.

➤ Tungsten, which has the highest melting point and the greatest strength of all the metals, is a promising material for application in rocket motors.

➤ The mitochondrion, a tiny cell particle, has been successfully taken apart and put back together again by scientists.

➤ All soil, rocks, and sand are slightly radioactive, but rarely if ever do they radiate enough to be harmful to plants, animals, or humans.

➤ Every year from Oak Ridge National Laboratory alone 14,000 shipments of nearly 100 different isotopes are made.

➤ The gas ionization chamber together with a sensitive and stable electrometer constitutes one of the simplest and yet most accurate methods of detecting radiation.

➤ The substitution of polyurethane foam in place of conventional sandwich construction components results in a cheaper, lighter and stronger fin for rockets.

➤ Urethane foam is sprayed inside cabs of electric utility company trucks in Canada for insulation keeping them warm in the winter and cool in the summer.